

Application No. 09/342,729

Reply to Office Action of November 19, 2003

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims

1. (Currently Amended) An image pickup apparatus comprising:

an array of unit cells arranged in rows and columns, each unit cell having a light-receiving device configured to receive light and generate an electric charge corresponding to the light, a charge-accumulating section configured to accumulate the electric charge generated by the light-receiving device, a transfer device configured to transfer the electric charge from the light-receiving device to the charge-accumulating section, a charge-limiting device configured to limit the electric charge accumulated in the charge-accumulating section, and an amplifying device configured to amplify a voltage signal corresponding to the electric charge in the charge-accumulating section;

a plurality of vertical signal lines extending along the columns of unit cells, respectively, each configured to receive the amplified voltage signal amplified by the amplifying device of any unit cell of the associated column; and

a control circuit configured to control each of the unit cells, to cause the charge-limiting device to limit the electric charge generated by the light-receiving device during a first period and transferred to the charge-accumulating section through the transfer device, to cause the charge-accumulating section to hold the electric charge limited by the charge-limiting device, and to add to the electric charge held in the charge-accumulating section, an electric charge generated by the light-receiving device during a second period following the first period and transferred to the charge-accumulating section through the transfer device.

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2. (Original) An image pickup apparatus according to claim 1, wherein the control circuit controls each of the unit cells of the same row such that the charge-limiting device limits the charge accumulated in the charge-accumulating section, during a horizontal blanking period, and the charge transferred to the charge-accumulating section is added to the charge accumulated in the charge-accumulating section, during a different horizontal blanking period.

3. (Original) An image pickup apparatus according to claim 1, wherein the control circuit controls the unit cells such that the charge-limiting device limits the charge to be accumulated in the charge-accumulating section and the charge transferred to the charge-accumulating section is added to the charge accumulated in the charge-accumulating section, during the same vertical blanking period in all cell units.

4. (Original) An image pickup apparatus according to claim 1, wherein the first period is longer than the second period.

5. (Currently Amended) An image pickup apparatus comprising:

an array of unit cells arranged in rows and columns, each unit cell having a light-receiving device configured to receive light and generate an electric charge corresponding to the light, a charge-accumulating section configured to accumulate the electric charge generated by the light-receiving device, a first transistor having a first control terminal and connected between the light-receiving device and the charge-accumulating section, configured to transfer the electric charge generated in the light-receiving device to the charge-accumulating section when a transfer signal is supplied to the first control terminal, a second transistor having a second control terminal and connected to the charge-accumulating section,

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configured to limit the electric charge accumulated in the charge-accumulating section when a voltage between off voltage and on voltage is applied to the second terminal, and a third transistor configured to amplify a voltage signal corresponding to the electric charge in the charge-accumulating section;

a plurality of vertical signal lines extending along the columns of unit cells, respectively, each configured to receive the amplified voltage signal amplified by the amplifying device of any unit cell of the associated column; and

a control circuit configured to control each of the unit cells, to cause the second transistor to limit the electric charge generated by the light-receiving device during a first period and transferred to the charge-accumulating section through the first transistor, to cause the charge-accumulating section to hold the electric charge limited by the second transistor and to add to the electric charge held in the charge-accumulating section, an electric charge generated by the light-receiving device during a second period following the first period and transferred to the charge-accumulating section through the first transistor.

6. (Currently Amended) A method of controlling an image pickup apparatus comprising: an array of unit cells arranged in rows and columns, each unit cell having a light-receiving device configured to receive light and generate an electric charge corresponding to the light, a charge-accumulating section configured to accumulate the electric charge generated by the light-receiving device, a transfer device configured to transfer the electric charge from the light-receiving device to the charge-accumulating section, a charge-limiting device configured to limit the electric charge accumulated in the charge-accumulating section, and an amplifying device configured to amplify a voltage signal corresponding to the electric charge in the charge-accumulating section; a plurality of vertical signal lines extending along the columns of unit cells, respectively, each configured to receive the

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amplified voltage signal amplified by the amplifying device of any unit cell of the associated column, said method comprising:

transferring the electric charge generated by the light-receiving device during a first period to the charge-accumulating section through the transfer device;

limiting the electric charge transferred to the charge-accumulating section, by means of the charge-limiting device;

holding the electric charge limited by the charge-limiting device, in the charge-accumulating section; and

transferring the electric charge generated by the light-receiving device during a second period following the first period, to the charge-accumulating section through the transfer device, thereby adding the electric charge generated during the second period to the electric charge held in the charge-accumulating section.

7-10. (Cancelled).

11. (Currently Amended) An image pickup apparatus, comprising:

an array of unit cells arranged in rows and columns, each unit cell having a light-receiving device configured to receive light and generate an electric charge corresponding to the light, a charge-accumulating section configured to accumulate the electric charge generated by the light-receiving device, a transfer device configured to transfer the electric charge from the light-receiving device to the charge-accumulating section, and an amplifying device configured to amplify a voltage signal corresponding to the electric charge accumulated in the charge-accumulating section;

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a plurality of vertical signal lines extending along the columns of unit cells respectively, each configured to receive the amplified voltage signal amplified by the amplifying device of any unit cell of the associated column; and

a control circuit configured to control the unit cells such that the transfer device transfers the electric charge from the light-receiving device to the charge-accumulating section, during a vertical blanking period common to all unit cells, and configured to control the unit cells such that the charge-accumulating section holds the electric charge transferred from the light-receiving device until the amplifying device amplifies a voltage signal corresponding to the electric charge held in the charge-accumulating section.

12. (Cancelled).

13. (New) An image pickup apparatus according to claim 1, wherein the light-receiving device is formed of a photodiode comprising an n-type region formed in a surface of a p-type substrate and a p-type region formed in a surface of the n-type region.

14. (New) An image pickup apparatus according to claim 5, wherein the light-receiving device is formed of a photodiode comprising an n-type region formed in a surface of a p-type substrate and a p-type region formed in a surface of the n-type region.

15. (New) A method of controlling an image pickup apparatus according to claim 6, wherein the light-receiving device is formed of a photodiode comprising an n-type region formed in a surface of a p-type substrate and a p-type region formed in a surface of the n-type region.

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16. (New) An image pickup apparatus according to claim 11, wherein the light-receiving device is formed of a photodiode comprising an n-type region formed in a surface of a p-type substrate and a p-type region formed in a surface of the n-type region.